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MOISTURE CONTENT OF THE SEWAGE SLUDGE DRIED USING THERMAL DRYER

Zakaria M. S., Suhaimi Hassan and M. Faizairi
Faculty of Mechanical Engineering, Universiti Teknologi Petronas, Malaysia
E-Mail: safuan_one89@yahoo.com

ABSTRACT

Recently, the world's dependence on conventional fuels as the primary source of energy and the environmental impact as a consequence of utilizing these fuels, it is found that the use of renewable energy is in urgent need at the present time. Currently, utilization of biomass residue as a source of energy is becoming very promising as it not only reduces the dependence on fossil fuels and the related environmental impact but also assist in solving the long-term problems related to the disposal of these materials. The problem with as-received biomass residue is, however, the difficulty of use as a source of energy due to its high moisture content, low density and issues related with handling, storage and transportation. One of the ideal solution to dispose the sludge is by converting it into useful energy in form of solid fuel such as pallet and briquette. This solution not only solve the sludge disposal problem but also generate energy to mankind. However, the main problem faced in order to convert this sludge into energy is it contains high moisture content which is more than 90% of moisture content. In order to convert it into useful energy, the moisture content of the sludge need to reduce into acceptable level which is below 20% . One of the method to remove the moisture content is by using thermal dryer. This paper discussing about the moisture content of the sewage sludge dried using the thermal dryer. The preliminary result obtain from the research found that the moisture content of the sewage sludge can be reduce up to 10.82% depending on the speed and the temperature of the dryer.

Keywords: sewage sludge, thermal dryer, solid fuel, moisture content, energy.

INTRODUCTION

Energy demands in Malaysia are increasing sharply due to the growth of population and economy. Malaysia as a developing country has achieved the population of 27.4 million in 2007 and expected to reach 33.4 million and 37.4 million by the year of 2020 and 2030 respectively when considering the average of 1.8% growth rate yearly [1]. The situation of economic growth and population leads to an increasing of energy demands, whereby some changes happened in the energy consumption pattern which influenced by the tremendous demands from transportation, industry, commercial and residential sectors. It was reported recently that the generation of domestic wastewater sludge (DWS) recorded a 64.4% share in the total solid waste generation in Malaysia surpassing Municipal Solids Wastes (MSW) [2]. This increase is indirectly elevating local environmental problems and special treatment will need to be employed to manage these waste due to its toxic and potentially harmful nature [3]. The management of DWS residue will also slowly increase the financial burden of wastewater treatment companies in Malaysia. This is especially critical when the population increases, as is faced in many urban and suburban areas in Malaysia [4]. One of the ideal solution is to convert the sewage sludge into useful solid fuel such as pallet as briquette. In order to convert the sewage sludge into useful fuel, the moisture content of the sewage sludge must be below than 20 % [5]. Therefore, the thermal dryer was using in order to reduce the moisture content of the sewage sludge into the acceptable level and converting into useful solid fuel.

METHODOLOGY

The thermal dryer consists of 2 main component which is dryer and feeder. The electric motor will drive the screw conveyor in feeder to transport the wet sewage sludge into the dryer continuously. There are 5 variable speeds that available for the electric motor that driven the screw conveyor in the feeder and the dryer. The proposed thermal dryer as presented in the Figure-1.

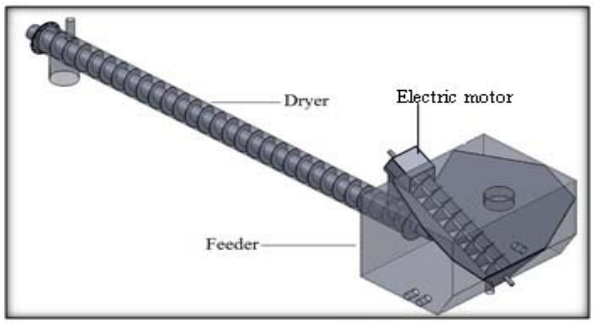

Figure-1. Proposed thermal dryer.

The sample of the sewage sludge was obtained from the local wastewater treatment plant and subjected to thermal drying by using proposed thermal dryer. The raw sewage sludge was tested in the proposed thermal dryer by various operating conditions of the thermal dryer. The parameters that interested in the production of the thermal dryer are moisture content and calorific value. In order to convert the sewage sludge into energy, the moisture content of sewage sludge must be below than 20 % as suggested by [6-9]. In order to determine the initial moisture content of the sewage sludge, a few sample of

the sewage sludge was subjected to fully drying in the oven for 24 hours with temperature of 110^0. The moisture contents of the samples were measured using a CARBOLITE 450 electric oven according to ASAE S358.2 Standard. According to ASAE S358.2 Standard the moisture content in wet basis was calculated as follows:

$$MC(\%) = \frac{\text{Loss in Weight} \times 100}{\text{Weight of Wet Sample} \times 100}$$

The electric motor will drive the screw conveyor in feeder to transport the wet sewage sludge into the dryer continuously. There are 5 variable speeds that available for the electric motor that driven the screw conveyor in the feeder and the dryer.

The electric motor used to drive the screw conveyor in feeder has 1420 round per minutes (RPM) at 50 Hz. The inverter was used in order to reduce the speed of the electric motor. The graph of variable frequency RPM of the electric motor in the feeder as presented in the Figure-2.

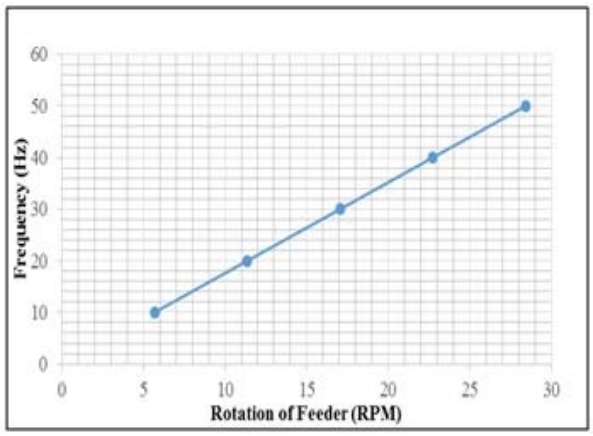

Figure-2. The rotation of the feeder for thermal dryer.

RESULT AND DISCUSSION

Figure-3 represents the moisture content of the sewage sludge with various power ratings and speed of screw conveyor in the dryer. The highest moisture content for this condition was at power rating of 135 kW and 10.19 RPM of the screw conveyor in the feeder which is 54.05 %. The lowest moisture content for this condition was at power rating of 310 kW and 2.04 RPM of the screw conveyor in the feeder which is 10.82 %. Since the acceptable level of moisture content for the sewage sludge was 20 %, there are 13 samples of sewage sludge that have the moisture content about 20 % and below for this operating condition. The conclusion that can be made for this graph was the power rating must be higher than 240 kW in order to obtain the production of sewage sludge with less than 20% of moisture content.

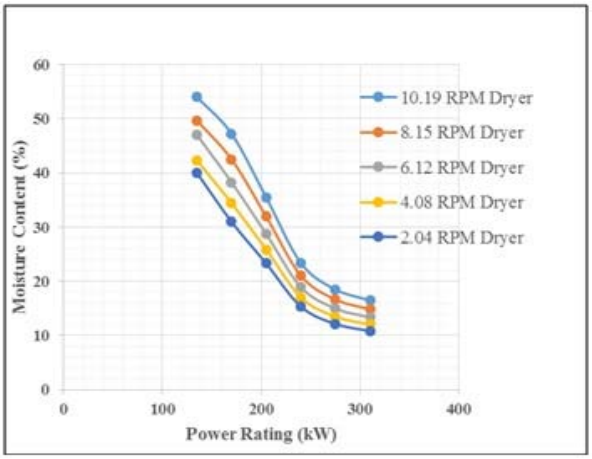

Figure-3. The moisture content of the sewage with various speed of screw conveyor in the dryer.

From the observation, the lowest speed of the screw conveyor in the feeder required less heat in order to reduce the moisture content of the sewage sludge below than 20% compared to the highest speed of the screw conveyor. From the Figure-3, the screw conveyor of the dryer was at 2.04 RPM and required 240 kW of the power rating. However, the highest speed of the screw conveyor in the dryer which is 10.19 RPM required at least 275 kW of power rating in order to reduce the moisture content of sewage sludge into below than 20%. This is because the lowest speed of the screw conveyor will increase the drying time to reduce the moisture content into below than 20%. The highest speed of the screw conveyor will reduce the drying time of the sewage sludge, hence required high temperature in order to reduce the moisture content in the sewage sludge into below than 20%. Therefore, the higher speed of the screw conveyor in the feeder required higher power rating of the burner in order to supply enough heat for obtaining sewage sludge with less than 20% moisture content.

CONCLUSIONS

The proposed thermal dryer successfully reduced the moisture content of the sewage sludge into acceptable level which is below than 20% for conversion into solid fuel. The highest speed of the screw conveyor in the dryer required high power of burner to reduce the moisture content in the sludge into acceptable level and vice versa.

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